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α-Metildopa'nın Voltametrik Tayini

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Özet: *Tekrar edilebilir sonuçlar elde etmek için, özel bir ön işlem görmüş platin tel ve karbon elektrodlarla, α-metildopa'nın asidik ortamdaki elektrokimyasal davranışı, voltametrik olarak incelenmiştir. Kaydedilen voltamogramlardan α-metildopa'nın platin elektrodla, 10mVs^{-1} tarama hızı ile 2.10^{-5} - 3.10^{-3} M konsantrasyon aralığında tayin edilebileceği bulunmuştur. Bu voltametrik yöntem, Türkiye'de antihipertansif olarak kullanılan, α-metildopa içeren tablet'lere uygulanmıştır. USP standart yöntemi ile karşılaştırma yapılmış ve voltametrik yöntemle elde edilen sonuçların USP yönteminde elde edilen sonuçlara yakın doğruluk ve duyarlıkta olduğu gösterilmiştir.*

VOLTAMMETRIC DETERMINATION OF α-METHYLDOPA

Summary: *The electrochemical behaviour of α-methyldopa in acidic media was investigated voltammetrically using carbon and platinum wire electrodes pretreated in a special manner in order to obtain reproducible results. From the recorded voltammograms it was concluded that α-methyldopa can be determined with platinum electrode in the concentration range of 2.10^{-5} - 3.10^{-3} M with a scan rate of 10 mVs^{-1}. This voltammetric method was applied to the determination of this substance in tablets used for antihypertensive purposes in Turkey. A comparison with official USP method showed that the proposed voltammetric method have comparable precision and accuracy.*

Keywords: *α-methyldopa, Voltammetry, Platinum electrode, Carbon electrode.*

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INTRODUCTION

L-α-methyldopa (L-3-(3,4-dihydroxyphenyl))-2-methyl alanine is an important hypotensive agent. Various chemical methods for the determination of this substance are available. Chromatography (1, 2, 3, 4), titrimetry (5, 6), spectrophotometry (7, 8, 9, 10, 11) and fluorometry (12, 13) have been applied to the determination of α-methyldopa in dosage forms and biological fluids. These methods are highly sensitive and spesific but involve separation and other manipulative steps. The reported electrochemical results had been obtained with various carbon (14, 15, 16) and rotated metal electrodes (17) and by hydrodynamic voltammetric techniques (18, 19).

In this paper an investigation into the electroanalytical behaviour of α-methyldopa using platinum and carbon electrodes to obtain the experimental results under optimum conditions is presented. The proposed technique has been applied to the analysis of pharmaceutical dosage forms in Turkey and compared to the USP method (20).

MATERIAL and METHOD

Apparatus:

A three-electrode potentiostatic polarograph (Tacussel PRG-3) was used in the voltammetric determinations. A saturated calomel Tacussel type C-10 was used as reference and a carbon electrode (M.K.E. TURKEY) and a platinum wire in 1.0 mm diameter (Tacussel) were used as working electrodes. The counter electrode was a platinum wire (Johnson Matthey). Although the potentials were measured with reference to a saturated calomel electrode all the potential values in the text were given relative to a standart hydrogen electrode.

Chemicals:

The α-methyldopa used as a standard was obtained from Fako-Turkey. Aldomet® tablets containing α-methyldopa (250 mg dosage) were obtained from local drugstores. The 10^{-3} M standard stock solution was prepared by solving the weighed amount of α-methyldopa in 0.5 M H_2SO_4 as supporting electrolyte. Solutions of different concentrations in which voltammograms were recorded were obtained by dilution of this stock solutions. Doubly distilled water was used for preparing the solutions. A Shimadzu UV-160 spectrophotometer was used for spectrophotometric measurements.

The platinum working electrode was electrochemically pretreated prior to each experiment in order to obtain a clean surface which permitted reproducible results. For this purpose the electrode was anodized at 1.45 V for 5 minutes and after throughly washing with doubly distilled water, it was allowed to stand + 0.35 V for 15 minutes in 1 N H_2SO_4 by bubbling nitrogen through the solution. The carbon electrode was cleaned only mechanically by grinding with a fine emery paper.

Application of The Method to The Pharmaceutical Dosage

Forms:

Aldomet tablets, solid dosage forms of α-methyldopa, were assayed by voltammetric method. For this purpose 10 tablets were weighted accurately and ground to a fine powder an aliquot equivalent to 250 mg α-methyldopa was weighed and dissolved in 0.5 M H_2SO_4 and diluted to 100 ml in a volumetric flask. The solution was stirred for 1 hour with a magnetic stirrer and a portion of this solution transferred to a tube and santrifugated. 40 ml of the clean solution at the top of the tube were taken into a volumetric flask and made up to 100 ml with 0.5 M H_2SO_4. Voltammograms of this solution were obtained under the same working conditions which voltammograms of standards were recorded.

RESULTS and DISCUSSION

The effects of the nature and the concentration of the supporting electrolyte and the scan rate on the results from the view point of analytical evoluation were investigated. The best results were obtained in 0.5 M H_2SO_4 with a scan rate of 10 mVs^{-1}.

In Figure I, voltammograms of 4.10^{-4} M α-methyldopa in 0.5 M H_2SO_4 recorded with different scan rates are seen on curve I the peak at 950 mV corresponds to the oxidation of the substance to dopaquinone. As the scan rate increases the potantial of this peak shifts to more positive potential regions.

Figure II reveals that on cathodic branch the peak at 650 mV corresponds to the reduction of the oxidation products as well as the reduction of PtO_2 formed at the anodic branch. This means that the oxidation of α-methyldopa and the reduction of dopaquinone take place at the same potentials with the surface oxide formation and reduction. With a scan rate of 10 mVs^{-1} the reaction seemed to be close to the reversibility.

On carbon electrode the oxidation of α-methyldopa take place at 750 mV the supporting electrolyte is 0.5 M H_2SO_4. Figure III showes the voltammograms of α-methyldopa recorded using carbon electrode. The curves obtained with this electrode are reversibl if the scan rate is 10 mVs^{-1}. As the scan rate increases the curves become more irreversibl. It is important to note that with carbon electrode the sensitivity is low and any quantitative interpretation could not be made for this electrode.

Voltammograms recorded in 0.5 M H_2SO_4 supporting electrolyte solutions having different concentrations of α-methyldopa with a scan rate of 10 mVs^{-1} are seen in figure IV. A linear relationship between the peak currents and concentration in the range of 2.10^{-5} - 3.10^{-3} M was obtained. The results of the linear regression analysis of this relationship given in Table I showed that the quantitative analysis of this substance could be made by the proposed method.

The selectivity of the method was assayed by exposing the test solution to UV light for 15 minute. A marked

decrease in the current was observed at the end of this period revealing that the method is selective in presence of the decomposition products.

The quantitative determination of Aldomet® tablets were performed also by USP (20). The results of the analysis by the two methods were given in Table II. As it can be seen from statistical data there is no significant difference between the two methods.

The authors wish to thank Fako İlaçları A.Ş. İstanbul, TURKEY, for supply of α-methyldopa.

Tab. I. Result of linear regression analysis of concentration-peak current relations at 950 mV.

Table I

Concentration (mol/l)	2.10^{-5}	4.10^{-5}	6.10^{-5}	8.10^{-5}	1.10^{-4}	2.10^{-4}	4.10^{-4}	6.10^{-4}	8.10^{-4}	1.10^{-3}	2.10^{-3}	3.10^{-3}
Peak Current (μA)	2	3	3.5	4	6	10	17	25	34	42	81	122.5
Correlation Coefficient	0.9999											
Slope	$4.03.10^4$											
y-intercept	1.32											
Standard Deviation	1.69											

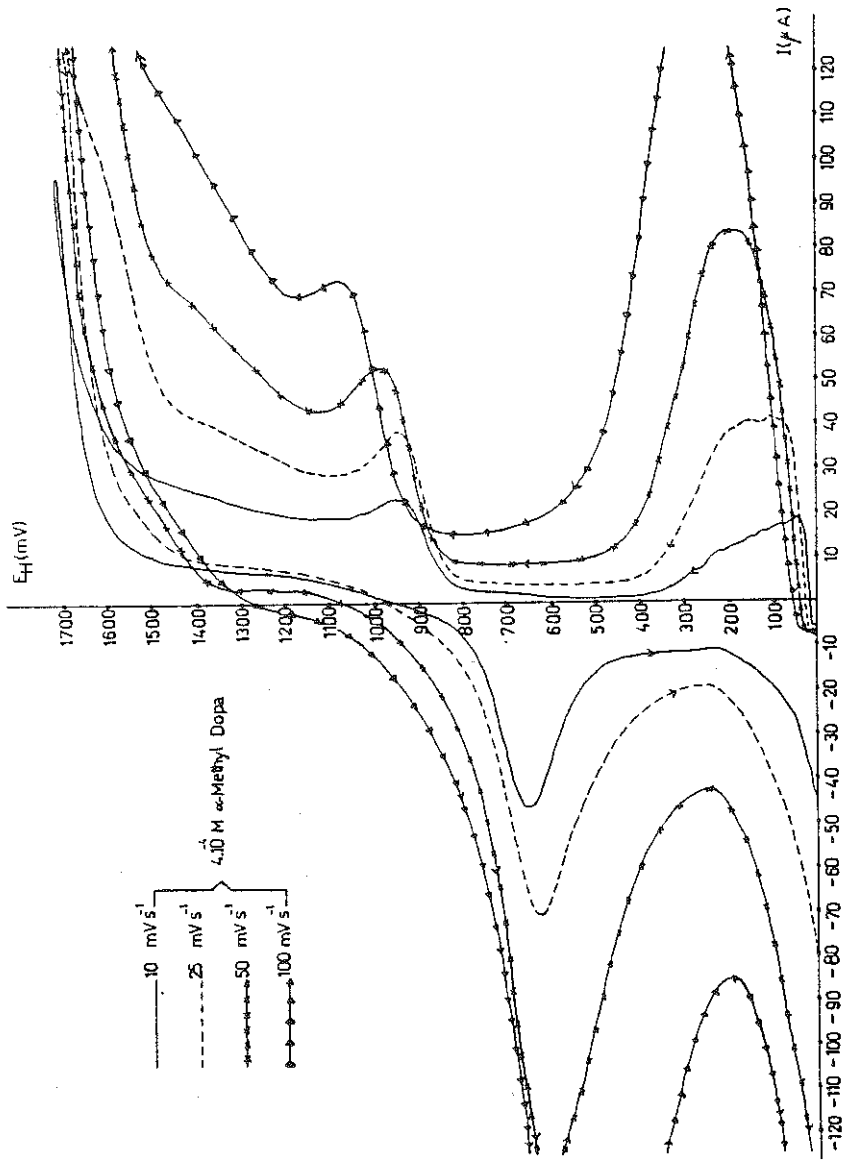

Fig. I. Voltammograms of 4.10^{-4} M α-methyldopa in 0.5 M H_2SO_4 recorded with different scan rates with platinum electrode.

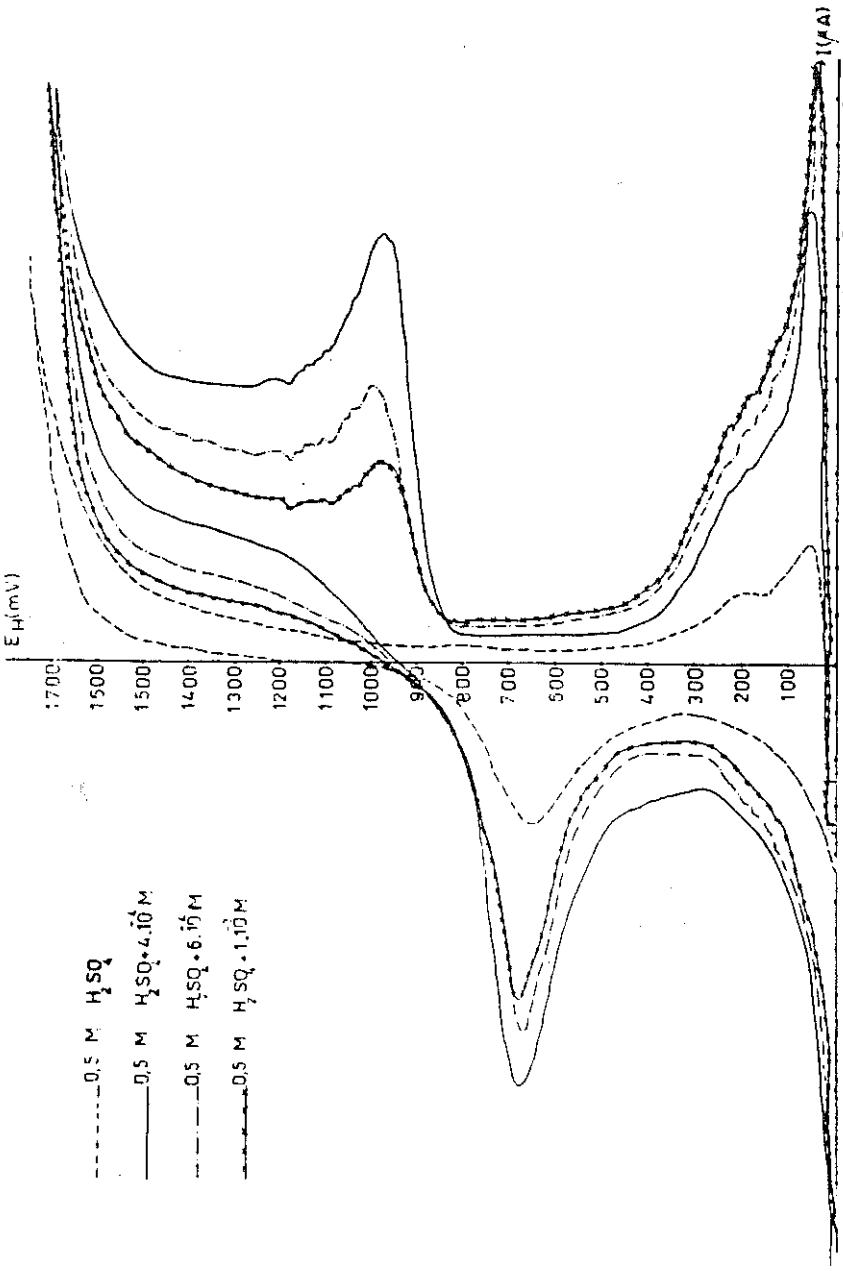

Fig. II. Cyclic voltammograms obtained in 0.5 M H_2SO_4 having different concentration of α-methyldopa with platinum electrode.

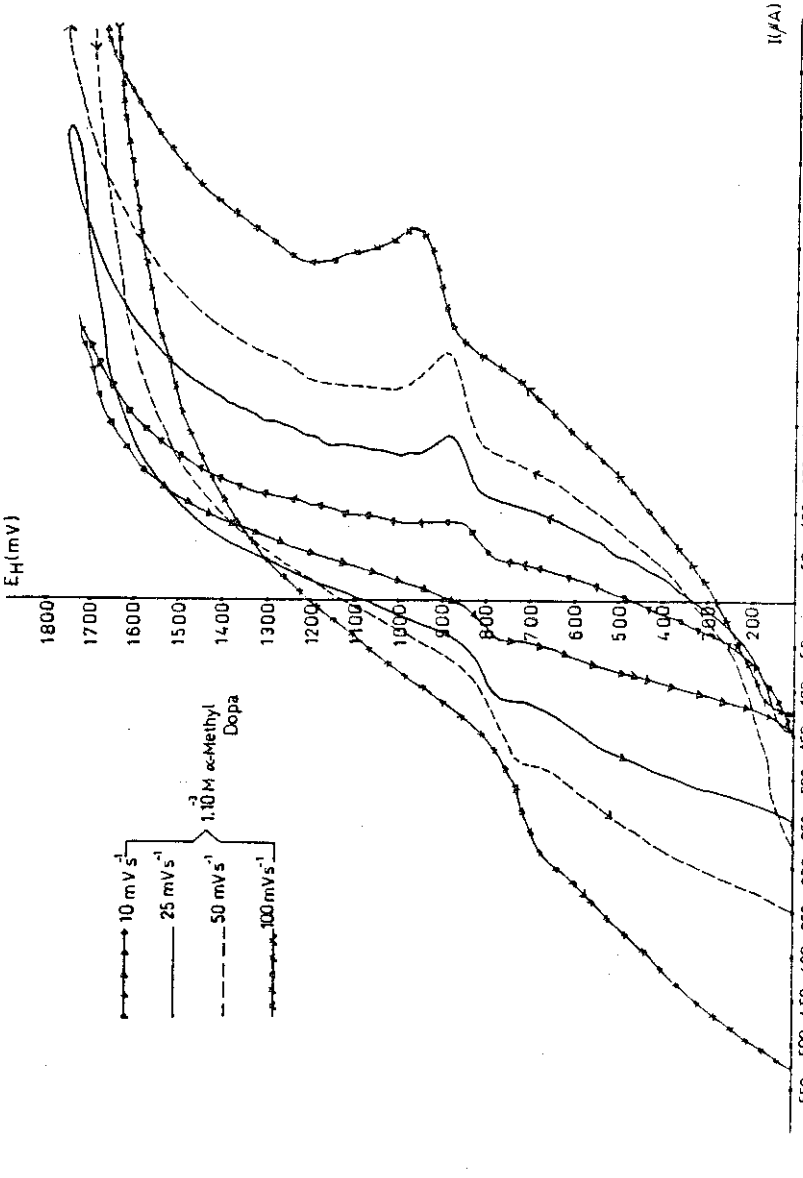

Fig. III. Voltammograms of 1.10^{-3} M α-methyldopa in 0.5 M H_2SO_4 recorded with different scan rates with carbon electrode.

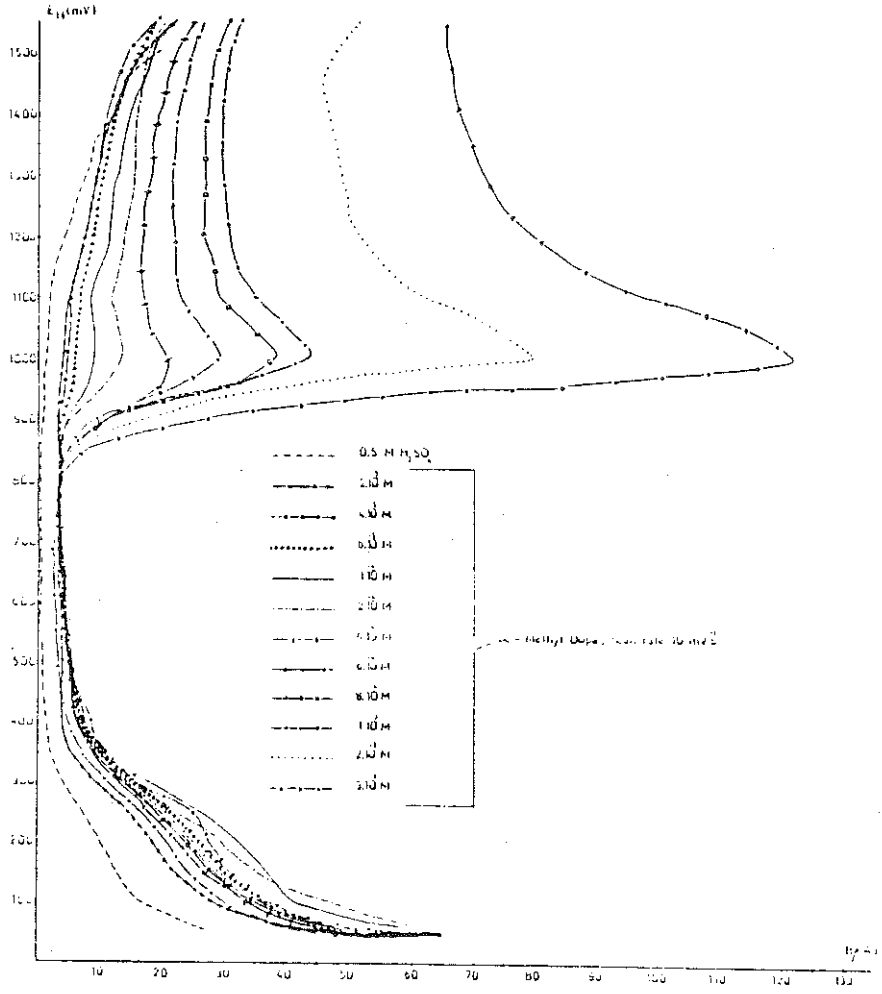

Fig IV. Voltammograms obtained for 0.5 M H_2SO_4 containing various concentrations of α-methyldopa. Scan rate, 10 mVs^{-1}.

Table II

Sample No.	Found by spectrophotometric method/mg per tablet	Found by voltammetric method/mg per tablet
1	252.9	252.5
2	251.8	250.8
3	252.4	249.5
4	250.6	250.8
5	251.8	250.8
6	253.6	252.5
7	251.2	254.5
8	250.6	249.5
9	252.4	250.8
10	253.6	249.5
Mean value	252.09 ± 0.68	251.12 ± 0.99
Standard deviation	1.09	1.61
Standard error	0.35	0.51
Theoretical value	250	250
Difference between means	0.97	
Confidens interval for difference in means		95 percent (P = 0.05)

Tab. II. Results of the analysis of Aldomet® tablets for α-methyldopa.

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